Annex-1
No. 3/4/2016-Trans

Date/ time of the meeting: 9.5.2017 at 3 pm
Venue: Ministry of Power, Conference Room
Shram Shakti Bhawan, New Delhi-110001

List of Participants

Ministry of Power

1. Ms. Shalini Prasad, Additional Secretary (SP) - In the Chair
2. Shri Irfan Ahmad, Director (Trans)

Ministry of Urban Development

3. Shri Mohd. Monis Khan, Town & Country Planner,
   Mobile: 9818158485, Telefax: 011-23370620, Email: khanmonis@gmail.com

Central Electricity Authority (CEA)

4. Shri Ravinder Gupta, Chief Engineer,
   Mobile: 9968286184, Email: ravindergupta_cea@rediffmail.com
5. Shri S.K. Ray Mohapatra, Chief Engineer,
   Mobile: 9818527857, Email: skmohapatra@rediffmail.com
6. Shri Awadesh Yadav, Director (PSPA-I)
   Phone: 011-26732318/Mob: 9868664087/Email: awd.cea@gmail.com
7. Shri Upendra Kumar, Director CEI
   Mobile: 9910180485, Telefax: 011-26510249, Email: upendra0309@gmail.com
8. Shri M. Srikanth Reddy, Assistant Director,
   Mobile: 8447272084, Email: adptcl@gmail.com
9. Shri P.K. Sangwan, Assistant Director,
   Mobile: 9560741071, Telefax: 011-26732711, Email: pksangwan@nic.in

Power Grid Corporation Of India Limited (PGCIL)

10. Shri A. K. Sinha, ED,
    Mobile: 9425293910, 0124-2571980, Email: ak_sinha@powergridindia.com
11. Shri A.K. Vyas, Addl. GM
    Mobile: 9910378107, Email: akvyas@powergridindia.com

Govt. of Haryana/ HVPNL

12. Shri Gulshan Nagpal, SE
    Mobile: 9313472660, Email: setsfbd@rediffmail.com

Govt. of Uttar Pradesh/ UPPTCL

13. Shri Yatendra Kumar, SE (T), Ghaziabad,
    Mobile: 7290059601, Email: cetw@upptcl.org
14. Shri Mohd. Ishaq, SE,
    Mobile: 7290059601, Email: seetegn@gmail.com

Govt. of Karnataka

15. Shri A.K.Tiwari, Resident Commissioner,
    Mobile: 9868393900, Email: rckarnatakanewdelhi@gmail.com

Govt. of Kerala/ KSEBL

16. Smt. Vijayakumari. P, Director
    Mobile: 9446008444, Email: mtkseb@ksebnet.com
17. Smt. Sheela M Daniel, Resident Engineer,
    Mobile: 9599096599, 011-23381964, Email: ksebdelhi@gmail.com

Govt. of Maharashtra/ MAHATRANSCO

18. Shri Yogesh Pach Pande, SE (Maha Transco),
    Mobile: 9920103000, Telefax: 022-26595265, Email: yogeshpachpande@gmail.com

Appendix X

Minutes of the 7th meeting of the Urban RoW Committee Chaired by Ms. Bharati, Joint Secretary (Trans), Ministry of Power on 13.9.2017 regarding finalization of compensation in regard to Right of Way (RoW) for Transmission line falling in urban areas.

Joint Secretary (Trans), MoP welcomed the participants and sought views of attendees of the meeting about signing of the report for finalization of compensation in regard to Right of Way (RoW) for Transmission line falling in urban areas.

2. List of Participants is at Annex - 1.

3. Under Secretary (Trans), MoP stated that the in the last (6th) meeting of the Urban RoW Committee, held on 9.5.2017, Additional Secretary, MoP as the Chairperson of the Committee has requested the Committee members to send their additional comments, if any, within a week, so that the final report could be released. He also informed that Member Secretary of the Committee, vide letter dated 14.6.2017, has informed that no additional comments were received from committee members and thus the final report was submitted to MoP.

4. Thereafter, a meeting was called on 13.9.2017 to sign the final report of the Urban RoW Committee. However, it was noted by the Chair that committee members from Sate Govts. have sent their representatives in the meeting, while the presence of members was required for signing the report.

5. Representatives of State Govts. of UP & Maharashtra requested that some clauses in the final report need further deliberations, for which another meeting of the Committee may be convened to make some changes & finalise the report. Representative of Govt. of Haryana stated that the proposed recommendations in the committee report will increase the compensation expenditure drastically affecting the viability of projects.

6. Joint Secretary (Trans), MoP urged the members of the Committee to send their comments on the Urban RoW Committee Report within a week, which can be considered by the Chairperson of the Committee and then a final meeting of the committee may be convened to make necessary changes in the report and get it signed by the members of the committee in the same meeting.

7. JS(Trans), MoP also desired that the State representatives, who have attended meetings of the Committee in past shall attend the next meeting of the Urban RoW Committee along with the Members of the Committee.

8. The meeting concluded with thanks to the Chair.

List of Participants

File No: *3/4/2016-Trans*

Chaired by: JS (Trans), MoP

Venue: Conference Room

Date: 13.9.2017

Meeting Subject: 7th meeting of the Urban RoW Committee Chaired by JS (Trans), MoP on 13.9.2017 regarding finalization of compensation in regard to Right of Way (RoW) for Transmission line falling in urban areas areas.

Ministry of Power

1. Smt. Bharati, JS (Trans) — In the Chair
2. Shri Bihari Lal, US

Central Electricity Authority

3. Shri P.S. Mhaske, Member PS
4. Shri Ravinder Gupta, CE (PSPA-I)
5. Shri Awdhesh Kr. Yadav, Director (PSPA-I)

Govt. of Karnataka

6. Shri S.N. Sharma, Resident Engineer
7. Shri Oeepak T.C., Resident Engineer

Govt. of Maharashtra

8. Shri Rajeev Kr Mital, CMO (MSETCL)

Govt. of Uttar Pradesh

9. Shri Chandra Mohan, Oir Operation (UPPTCL)
10. Shri Shailendra Gaur, SE (UPPTCL)

Govt. of Haryana

11. Shri Anil Kr Yadav, SE (HVPNL)

Appendix-XI

Minutes of the 8th Meeting of the Committee for finalization of compensation in regard to Right of Way (RoW) for transmission lines falling in urban areas.

Venue: NPMC Room, Shram Shakti Bhawan, New Delhi **Date: 14.3.2018**

List of participants is enclosed at **Annex.**

2. Initiating the discussion, JS(Trans) emphasised the need of early finalisation of report on Urban RoWand requested the representatives of various States to furnish their comments on the draft report so that any further changes, if required, may be made in the report and it may be finalised at the earliest.

3. Following observations/ comments were made by various participants in the meeting:

3.1 Maharashtra:

(i) Definition of "Urban Area" need to be clarified in the Report.

(ii) Further reduction in RoW with the use of advanced technologies should be allowed with the approval of CEA. It would act as incentive to States/ TRANSCOs for adopting new and innovative technologies.

(iii) Annuity based compensation should be removed.

(iv) States should be given liberty to decide rate of urban RoW compensation instead of fixing it to a particular limit.

3.2 Karnataka:

(i) Raised concerns about peri-urban areas, which are likely to be affected more compared to urban areas. This concern was supported by other participants too.

(ii) Population of the area should also be considered while deciding the urban area.

(iii) Urban RoW Guidelines should be restricted to bigger cities only.

3.3 M/o Urban Development:

(i) MoUD representative stated that their Ministry has circulated Urban & Regional Development Plans Formulation & Implementation (URDPFI) Guidelines: (a) Core area of planning (b) Specific & Investment planning; which may be utilised for finalisation of Urban RoW compensation.

3.4 Kerala:

(i) Requested for additional compensation clause in the Guidelines.

(ii) Definition of Tower Base Area should be changed. It should be based on concrete area rather than leg to leg area.

4. After detailed deliberations, following was decided to be included in the draft report:

(i) Definition of Urban area should be defined in the guidelines. CEA in consultation with MoUD would work out the definition of urban areas for the purpose of RoW.

(ii) Further reduction in RoW requirement at various voltage levels (with the technological advancement, maintaining adequate safety clearances) vis-a-vis as given in the Urban RoW report may be allowed with the approval of CEA and in this case, compensation for the reduced RoW requirement should be allowed. In this regard, a suitable paragraph would be included in the Urban RoW report.

(iii) The option of providing annuity based compensation may be removed from the recommendation of the Urban RoW report.

(iv) To provide up to 15% additional compensation for the RoW requirement in the urban area.

(v) The definition of tower base area to include the area bounded by concrete (as visible from outside) of the four legs of the tower.

5. The changes as proposed above shall be included in the RoW guidelines after receiving the observations of members of the Committee. Members were requested to provide their comments, if any, within one month from date of issue of the minutes. Revised guidelines, incorporating the above changes, shall be circulated to all concerned before getting the same approved by the Competent Authority.

6. Meeting ended with thanks to all.

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Annex
No. 3/4/2016-Trans

Date/ time of the meeting: 14.3.2018 at 10.30 am
Venue: Ministry of Power, NPMC Room, Shram Shakti Bhawan, New Delhi-110001.

Sub: 8th Meeting of the Committee for finalization of compensation in regard to Right of Way (RoW) for transmission lines falling in urban areas.

List of Participants

Ministry of Power

1. Smt. Bharati, Joint Secretary(Trans) - In the Chair
2. Shri Dhiraj Kumar Srivasatva, Director (Trans)
3. Shri Bihari Lal, Under Secretary (Trans)

Central Electricity Authority

4. Shri P.S. Mhaske, Member (PS)
   Mobile:9968667741 Email:memberpscea@nic.in
5. Shri Ravinder Gupta, Chief Engineer (PSPA-I),
   Mobile: 9968286184, Email: ravindergupta_cea@rediffmail.com

Ministry of Housing Urban Development

6. Mohd. Monis Khan, Town & Country Planner
   Mobile:9818158485 Email:khanmonis@yahoo.com

Power Grid Corporation of India Limited (PGCIL)

7. Shri S.K. Gupta, ED (ESMD & CSR)
   Mobile:9766197771 Email:skgupta2@powergridindia.com
8. Shri A.K. Vyas, Addl. GM,
   Mobile: 9910378107, Email: akvyas@powergridindia.com

Govt. of Karnataka/KPTCL

9. Shri P. Ravi Kumar, Secretary (Energy),
   Mobile: 94418124242, Email: prs-energy@karnataka.gov.in

Govt of Kerala/KSEBL

10. Smt. Vijayakumari. P, Director,
    Mobile: 9446008444, Email: mtkseb@ksebnet.com
11. Smt. Sheela M Daniel, Resident Engineer,
    Mobile: 9599096599/011-23381964, Email: ksebdelhi@gmail.com

Govt. of Uttar Pradesh/UPPTCL

12. Shri A.K. Agrawal CE(TW)
    Mobile:9412749801 Email:cetw@upptcl.org
13. Shri S.K. Chaurasia , EE (Commercial)
    Mobile:8005461633 Email:eetbu@upptcl.org
14. Shri R.K. Saxena, S.E (Commercial)
    Mobile:9415311205 Email:director_comm@upptcl.org
15. Shri Yatendra Kumar, SE (T) MBD
    Mobile:9412749917 Email:
16. Shri Puneet Gupta, EE(Tr),NOIDA, ETD -1, NOIDA
    Mobile:7290059664 Email:eetdn@gmail.com

Govt. of Maharashtra/MSETCL/MSEB Holding Company

17. Shri Rajeev K. Mital, CMD
    Mobile:9769446924 Email:
18. Shri Prfulla Pathak, Resident Executive Director
    Mobile:9810120099 Email:msebdel@gmail.com

Govt. of Haryana/ HVPNL

19. Shri Anil Yadav SE/TS,GGN
    Mobile: 9350454131 Email:setsggn@gmail.com

Appendix XII

F. No. 7-25/ 2012-FC
Government of India
Ministry of Environment and Forests
(FC Division)

Paryavaran Bhawan,
CGO Complex, Lodhi Road,
New Delhi - 110 510
Dated: 5th May, 2014

To

The Principal Secretary (Forests),
All State / Union Territory Governments

Sub: Guidelines for diversion of forest land for non-forest purposes under the Forest (Conservation) Act, 1980- Guidelines for laying transmission lines through forest areas - *reg*.

Sir,

I am directed to say that the Hon'ble National Green Tribunal in their Order dated 7th March 2012 in the Appeal No. 10 of 2012 in the matter of Janajagaritii Samiti (Regd.) versus Union of India and Others directed this Ministry to take steps and notify the detailed fresh guidelines for laying transmission lines through forest area, incorporating necessary changes to mitigate the difficulties which arise during granting forest clearance.

Accordingly, this Ministry in consultation with the Central Electricity Authority formulated revised guidelines for laying transmission lines through forest areas. **A copy of the same is enclosed.**

Yours faithfully,

Encl.: As above.

(H.C. Chaudhary)
Assistant Inspector General of Forests

Copy along with a copy of the said guidelines to:-

1. Prime Minister's Office (*Kind attn.:* Shri Santosh D. Vaidya, Director).
2. Secretary, Ministry of Power, Government of India, Shram Shakti Bhawan, New Delhi.
3. Principal Chief Conservator of Forests, all State/UT Governments.
4. Nodal Officer, the Forest (Conservation) Act, 1980, all State/UT Governments.
5. All Regional Offices, Ministry of Environment & Forests (MoEF), Government of India (GoI).
6. Joint Secretary in-charge, Impact Assessment Division, MoEF, GoI
7. All Assistant Inspector General of Forests/ Director in the Forest Conservation Division, MoEF, GoI.

GUIDELINES FOR LAYING TRANSMISSION LINES THROUGH FOREST AREAS

1. Where routing of transmission lines through the forest areas cannot be avoided, these should be aligned in such a way that it involves the least amount of tree cutting

2. As far as possible, the route alignment through forest areas should not have any line deviation.

3. (i) The width of right of way for the transmission lines on forest land shall be as follows:

Transmission Voltage	Width of Right of Way (Meter)
11kV	7
33 kV	15
66 kV	18
110 kV	22
132 kV	27
220 kV	35
400 kV S/C	46
400 kV D/C	46
+/- 500 kV HVDC	52
765 kV S/C (with delta configuration)	64
765 kV D/C	67
+/- 800 kV HVDC	69
1200 kV	89

(ii) In forest areas, only vertical delta configuration of 400 kV S/C and delta configuration of 765 kV S/C shall be permitted.

4. (i) Below each conductor or conductor bundle, following width clearance would be permitted for stringing purpose:

Transmission line with conductor bundle	Width clearance below each conductor or conductor bundle (meter)
Upto 400kV twin bundle	3

400 kV triple bundle	5
400 kV /+/- 500 kV HVDC /765 kV Quadruple bundle	7
+/- 800 kV HVDC / 765 kV hexagonal bundle	10

(ii) The trees on such strips would have to be felled but after stringing work is completed, natural regeneration will be allowed to come up. Felling/ pollarding/ pruning of trees will be done with the permission of the local forest officer wherever necessary to maintain the electrical clearance. One outer strip shall be left clear to permit maintenance of the transmission line.

(iii) During construction of transmission line, pollarding/ pruning of trees located outside the above width of the strips, whose branches/ parts infringe with conductor stringing, shall be permitted to the extent necessary, as may be decided by local forest officer.

(iv) Pruning of trees for taking construction/stringing equipments through existing approach/access routes in forest areas shall also be permitted to the extent necessary, as may be decided by local forest officer. Construction of new approach/access route will however, require prior approval under the Act..

(v) In the remaining width of right of way trees will be felled or lopped to the extent required, for preventing electrical hazards by maintaining the following:

Transmission Voltage	Minimum clearance between conductor and trees (Meters)
11 kV	2.6
33 kV	2.8
66 kV	3.4
110 kV	3.7
132 kV	4.0
220 kV	4.6
400 kV	5.5
+/- 500 kV HVDC	7.4
765 kV	9.0
+/- 800 kV HVDC	10.6
1200 kV	13.0

(vi) The maximum sag and swing of the conductors are to be kept in view while

working out the minimum clearance mentioned as above.

(vii) To avoid any hazard, felling/cutting/pruning of those trees which because of their height /location may fall on conductors shall also be permitted, as may be decided by local forest office.

(viii) In the case of transmission lines to be constructed in hilly areas, where adequate clearance is already available, trees will not be cut except those minimum required to be cut for stringing of conductors.

(ix) In case of transmission lines passing through National Parks, Wildlife Sanctuaries and Wildlife Corridors, insulated conductors shall only be used to prevent electrocution of animals.

5. Where the forest growth consists of coconut groves or similar tall trees, widths of right of way greater than those indicated at Sl. No.3 may be permitted in consultation with CEA.

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Appendix XIII

TABLE-2

RIGHT OF WAY CALCULATION FOR NORMAL ROUTE, FOREST AREA, URBAN AREA / POPULATED AREA / APPROACH SECTION NEAR SUBSTATION

Voltage level (kV)	Configuration	Conductor type	Terrain	Design Span (in m)	String Type	Horizontal clearance (in m) (2.0m+0.3 M for every additional 33 kV or part thereof (in m)	Insulator Length (Considered for Swing) (in m)	Max Sag at 85 Deg. C (in m)	Horizontal displacement from Conductor attachment point due to swing (in m)	**Width of right of way (in m)**	Maximum Horizontal distance of Conductor attachment point from centre of tower (in m)	**Approx. Width of right of way (in m)**	Electric field at edge of ROW (in kV/m)
A		**B**		**C**		**D**	**E**	**F**	**H=(E+F)* Sin35**	**R=2(D+H)+2X**	**X**	**R**	
765kV D/C	Vertical	ACSR ZEBRA	Normal Route	400	"I" String	9.0	7.6	13.3	12.0	**42+2X**	12.5	**67**	1.9
					"V" String	9.0	0	13.3	7.6	**33.2+2X**	10.5	**54**	2.7
					Tension	9.0	0	13.3	7.6	**33.2+2X**	14.5	**62**	
			Forest	300	"I" String	9.0	7.6	8.2	9.1	**36+2X**	12.5	**61**	2.9
					"V" String	9.0	0	8.2	4.7	**27+2X**	10.5	**48**	3.7
					Tension	9.0	0	8.2	4.7	**27+2X**	14.5	**56**	

			Urban area / populated area / approach section near substation	250	"I" String	9.0	7.6	6.1	7.9	**34+2X**	12.5	**59**	3.2
					"V" String	9.0	0	6.1	3.5	**25+2X**	10.5	**46**	4.2
					Tension	9.0	0	6.1	3.5	**25+2X**	14.5	**54**	
765kV S/C	Vertical /Delta	ACSR BERSIMIS	Plain	400	"I" String	9.0	7.1	14.8	12.6	**43.2+2X**	10.5	**64**	2.5
					"V" String	9.0	0	14.8	8.5	**35+2X**	9.5	**54**	3.2
					Tension	9.0	0	14.8	8.5	**35+2X**	13	**61**	
			Forest	300	"I" String	9.0	7.1	9.1	9.3	**36.6+2X**	10.5	**58**	3
					"V" String	9.0	0	9.1	5.2	**28.4+2X**	9.5	**47**	4.1
					Tension	9.0	0	9.1	5.2	**28.4+2X**	13	**54**	
			Urban	250	"I" String	9.0	7.1	6.8	8.0	**34+2X**	10.5	**55**	3.3
					"V" String	9.0	0	6.8	3.9	**25.8+2X**	9.5	**45**	4.5
					Tension	9.0	0	6.8	3.9	**25.8+2X**	13	**52**	

765kV S/C	Horizontal	ACSR BERSIMIS	Plain	400	"I" String	9.0	7.1	14.8	12.6	**43.2+2X**	15.6	**74**	3
					"V" String	9.0	0	14.8	8.5	**35+2X**	14.4	**64**	3.9
					Tension	9.0	0	14.8	8.5	**35+2X**	18.2	**71**	
			Forest	300	"I" String	9.0	7.1	9.1	9.3	**36.6+2X**	15.6	**68**	3.8
					"V" String	9.0	0	9.1	5.2	**28.4+2X**	14.4	**57**	5.1
					Tension	9.0	0	9.1	5.2	**28.4+2X**	18.2	**65**	
			Urban	250	"I" String	9.0	7.1	6.8	8.0	**34+2X**	15.6	**65**	4.2
					"V" String	9.0	0	6.8	3.9	**25.8+2X**	14.4	**55**	**5.5**
					Tension	9.0	0	6.8	3.9	**25.8+2X**	18.2	**62**	
±800kV HVDC	Horizontal	ACSR Lapwing	Plain/Forest/ Urban	400	"Y" String	10.6	5.3	14.9	11.6	**44.4+2X**	12.3	69	5.1
±500kV HVDC	Horizontal	ACSR Lapwing	Plain/Forest/ Urban	400	"V" String	7.4	0	14.9	8.5	**31.8+2X**	8.2	48	4.9

400kV D/C & S/C	Vertical	ACSR MOOSE	Plain	400	"I" String	5.6	4.0	13.3	9.9	**31+2X**	7.5	**46**	0.8
					"V" String	5.6	0	13.3	7.6	**26.4+2X**	6.0	**38**	1.1
					Tension	5.6	0	13.3	7.6	**26.4+2X**	9.7	**46**	
			Forest	300	"I" String	5.6	4.0	8.2	7.0	**25.2+2X**	7.5	**40**	1.5
					"V" String	5.6	0	8.2	4.7	**20.6+2X**	6.0	**33**	1.7
					Tension	5.6	0	8.2	4.7	**20.6+2X**	9.7	**40**	
			Urban	250	"I" String	5.6	4.0	6.1	5.8	**22.8+2X**	7.5	**38**	1.9
					"V" String	5.6	0	6.1	3.5	**18.2+2X**	6.0	**30**	2.3
					Tension	5.6	0	6.1	3.5	**18.2+2X**	9.7	**38**	
400kV S/C	Horizontal	ACSR MOOSE	Plain	400	"I" String	5.6	4.0	13.3	9.9	**31+2X**	10.9	**53**	2.3
					"V" String	5.6	0	13.3	7.6	**26.4+2X**	9.1	**45**	2.8
					Tension	5.6	0	13.3	7.6	**26.4+2X**	13.5	**53**	
			Forest	300	"I" String	5.6	4.0	8.2	7.0	**25.2+2X**	10.9	**47**	3.2
					"V" String	5.6	0	8.2	4.7	**20.6+2X**	9.1	**39**	4.6
					Tension	5.6	0	8.2	4.7	**20.6+2X**	13.5	**48**	

			Urban	250	"I" String	5.6	4.0	6.1	5.8	**22.8+2X**	10.9	**45**	3.6
					"V" String	5.6	0	6.1	3.5	**18.2+2X**	9.1	**36**	4.8
					Tension	5.6	0	6.1	3.5	**18.2+2X**	13.5	**45**	
1200kV	Horizontal	ACSR Moose	Plain/Forest/ Urban	400	"V" String	13.0	0	13.3	7.6	**41.2+2X**	24	89	5.3
220kV D/C / 230 kV DC	Vertical	ACSR ZEBRA	Plain	350	"I" String	3.8	2.5	10.6	7.5	**22.6+2X**	4.6	**32**	0.4
					"V" String	3.8	0	10.6	6.1	**19.8+2X**	4	**28**	
					Tension	3.8	0	10.6	6.1	**19.8+2X**	5.7	**31**	
			Forest	300	"I" String	3.8	2.5	8.2	6.1	**19.8+2X**	4.6	**29**	
					"V" String	3.8	0	8.2	4.7	**17+2X**	4	**25**	
					Tension	3.8	0	8.2	4.7	**17+2X**	5.7	**28**	
			Urban	200	"I" String	3.8	2.5	4.3	3.9	**15.4+2X**	4.6	**25**	1.1
					"V" String	3.8	0	4.3	2.5	**12.6+2X**	4	**21**	
					Tension	3.8	0	4.3	2.5	**12.6+2X**	5.7	**24**	

132kV D/C	Vertical	ACSR PANTHER	Plain	320	"I" String	2.9	2.3	7.5	5.6	**17+2X**	3.9	**25**	0.5
					"V" String	2.9	0	7.5	4.3	**14.4+2X**	3.5	**21**	
					Tension	2.9	0	7.5	4.3	**14.4+2X**	5.3	**25**	
			Forest	200	"I" String	2.9	2.3	3.6	3.4	**12.6+2X**	3.9	**20**	
					"V" String	2.9	0	3.6	2.1	**10+2X**	3.5	**17**	
					Tension	2.9	0	3.6	2.1	**10+2X**	5.3	**21**	
			Urban	150	"I" String	2.9	2.3	2.3	2.6	**11+2X**	3.9	**19**	0.9
					"V" String	2.9	0	2.3	1.3	**8.4+2X**	3.5	**15**	
					Tension	2.9	0	2.3	1.3	**8.4+2X**	5.3	19	
110 kV	Vertical	ACSR Panther	Plain	305	"I" String	2.9	2.1	6.86	5.1	**16+2X**	3.2	**22**	
					"V" String	2.9	0	6.86	3.9	**13.6+2X**	3.2	**20**	
					Tension	2.9	0	6.86	3.9	**13.6+2X**	4.4	**22**	
			Forest	200	"I" String	2.9	2.1	3.6	3.3	**12.6+2X**	3.2	**19**	
					"V" String	2.9	0	3.6	2.1	**10+2X**	3.2	**16**	
					Tension	2.9	0	3.6	2.1	**10+2X**	4.4	**19**	

			Urban	150	"I" String	2.9	2.1	2.3	2.5	**11+2X**	3.2	**17**	
					"V" String	2.9	0	2.3	1.3	**8.4+2X**	3.2	**15**	
					Tension	2.9	0	2.3	1.3	**8.4+2X**	4.4	17	
66kV	Vertical	ACSR PANTHER	Plain	250	"I" String	2.3	1.9	5.0	4.0	**12.5+2X**	2.5	**18**	
					"V" String	2.3	0	5.0	2.9	**10.4+2X**	2.5	**15**	
					Tension	2.3	0	5.0	2.9	**10.4+2X**	3.5	**17**	
			Forest	150	"I" String	2.3	1.9	2.3	2.4	**9.4+2X**	2.5	**14**	
					"V" String	2.3	0	2.3	1.3	**7.3+2X**	2.5	**12**	
					Tension	2.3	0	2.3	1.3	**7.3+2X**	3.5	**14**	
			Urban	100	"I" String	2.3	1.9	1.3	1.8	**8.3+2X**	2.5	**13**	
					"V" String	2.3	0	1.3	0.7	**6.1+2X**	2.5	**11**	
					Tension	2.3	0	1.3	0.7	**6.1+2X**	3.5	**13**	
66kV		ACSR DOG	Plain	250	"I" String	2.3	1.9	6.3	4.7	**14+2X**	2.5	**19**	
					"V" String	2.3	0	6.3	3.6	**11.8+2X**	2.5	**17**	
					Tension	2.3	0	6.3	3.6	**11.8+2X**	3.5	**19**	

			Forest	150	"I" String	2.3	1.9	2.9	2.8	**10.2+2X**	2.5	**15**	
					"V" String	2.3	0	2.9	1.7	**8+2X**	2.5	**13**	
					Tension	2.3	0	2.9	1.7	**8+2X**	3.5	**15**	
			Urban	100	"I" String	2.3	1.9	1.7	2.1	**8.8+2X**	2.5	**14**	
					"V" String	2.3	0	1.7	1.0	**6.6+2X**	2.5	**12**	
					Tension	2.3	0	1.7	1.0	**6.6+2X**	3.5	**14**	

Swing angle (in degrees)=35

Table 3 (Summarized)

RIGHT OF WAY CALCULATION FOR NORMAL ROUTE, FOREST AREA, URBAN AREA / POPULATED AREA / APPROACH SECTION NEAR SUBSTATION

Voltage level	*Configuration*	*Conductor type*	*Terrain*	*Ruling Span*	*String Type*	***RoW width (As per the current Practice (in m)***	***Revised RoW width in m (for compensation purpose)***
765kV D/C	Vertical	ACSR ZEBRA	Normal route without constraint	400	"I" String	**67**	**67**
					"V" String		
					Tension		
			Forest	300	"V" String	**67**	**56**
					Tension		
			Urban area / populated area / approach section near substation	250	"V" String	**67**	**54**
					Tension		
765kV S/C	Vertical /Delta	ACSR BERSIMIS	Normal route without constraint	400	"I" String	**64**	**64**
					"V" String		
					Tension		
			Forest	300	"V" String	**64**	**54**
					Tension		

Voltage level	*Configuration*	*Conductor type*	*Terrain*	*Ruling Span*	*String Type*	***RoW width (As per the current Practice (in m)***	***Revised RoW width in m (for compensation purpose)***
			Urban area / populated area / approach section near substation	250	"V" String	**64**	**52**
					Tension		
765kV S/C	Horizontal	ACSR BERSIMIS	Normal route without constraint	400	"I" String	**85**	**74**
					"V" String		
					Tension		
			Forest	300	"V" String	**85**	**65**
					Tension		
			Urban area / populated area / approach section near substation	250	"V" String	**85**	**62**
					Tension		
±800kV HVDC	Horizontal	ACSR Lapwing	Normal route without constraint/Forest/ Urban	400	"Y" String	69	69
±500kV HVDC	Horizontal	ACSR Lapwing	Normal route without constraint/Forest/ Urban	400	"V" String	52	52
400kV D/C	Vertical	ACSR MOOSE	Normal route without constraint	400	"I" String	**46**	**46**
					"V" String		
					Tension		

Voltage level	Configuration	Conductor type		Ruling Span	String Type	RoW width (As per the current Practice (in m)	Revised RoW width in m (for compensation purpose)
			Forest	300	"V" String	**46**	**40**
					Tension		
			Urban area / populated area / approach section near substation	250	"V" String	**46**	**38**
					Tension		
400kV S/C	Horizontal/ Vertical	ACSR MOOSE	Normal route without constraint	400	"I" String	**52**	**52**
					"V" String		
					Tension		
			Forest	300	"V" String	**52**	**47**
					Tension		
			Urban area / populated area / approach section near substation	250	"V" String	**52**	**44**
					Tension		
1200kV	Horizontal	ACSR Moose	Normal route without constraint/Forest/ Urban	400	"V" String	89	89
220kV D/C	Vertical	ACSR ZEBRA	Normal route without constraint	350	"I" String	**35**	**32**
					"V" String		
					Tension		

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Voltage level	*Configuration*	*Conductor type*	*Terrain*	*Ruling Span*	*String Type*	***RoW width (As per the current Practice (in m)***	***Revised RoW width in m (for compensation purpose)***
			Forest	300	"V" String	**35**	**28**
					Tension		
			Urban area / populated area / approach section near substation	200	"V" String	**35**	**24**
					Tension		
132kV D/C	Vertical	ACSR PANTHER	Normal route without constraint	320	"I" String	**27**	**25**
					"V" String		
					Tension		
			Forest	200	"V" String	**27**	**21**
					Tension		
			Urban area / populated area / approach section near substation	150	"V" String	**27**	**19**
					Tension		
110 kV D/c		ACSR PANTHER	Normal route without constraint	305	"I" String	**22**	**22**
					"V" String		
					Tension		
			Forest	200	"V" String	**22**	**19**
					Tension		

Voltage level	*Configuration*	*Conductor type*	*Terrain*	*Ruling Span*	*String Type*	***RoW width (As per the current Practice (in m)***	***Revised RoW width in m (for compensation purpose)***
			Urban area / populated area / approach section near substation	150	"V" String	22	**17**
					Tension		
66kV	Vertical	ACSR PANTHER	Normal route without constraint	250	"I" String	**18**	**18**
					"V" String		
					Tension		
			Forest	150	"V" String	**18**	**14**
					Tension		
			Urban area / populated area / approach section near substation	100	"V" String	**18**	**13**
					Tension		

Table 3 (detailed)

RIGHT OF WAY CALCULATION FOR NORMAL ROUTE, FOREST AREA, URBAN AREA / POPULATED AREA / APPROACH SECTION NEAR SUBSTATION

Voltage level	Configuration	Conductor type	Terrain	Ruling Span	String Type	Width of right of way (in m)		Maximum Horizontal distance of Conductor attachment point from centre of tower (in m)	Approx. Width of right of way (in m)	RoW width (As per the current Practice (in m)	Revised RoW width in m (for compensation purpose)	Reduction in RoW	**Indicative base width of normal tower at Concrete level (in m)
(1)		(2)	(3)	(4)	(5)	(6)		(7)	(8)	(9)	(10)	(11)	(12)
A		B		C		R=2(D+H)+2 X		X	R				
765kV D/C	Vertical	ACSR ZEBRA	Normal route without constraint	400	"I" String	42+	2X	12.5	67	67	67	0	16 - 25
					"V" String	33.2+	2X	10.5	54				
					Tension	33.2+	2X	14.5	62				
			Forest	300	"V" String	27+	2X	10.5	48	67	56	11	16 - 25
					Tension	27+	2X	14.5	56				
			Urban area / populated area / approach section near substation	250	"V" String	25+	2X	10.5	46	67	54	13	16 - 25
					Tension	25+	2X	14.5	54				

765kV S/C	Vertical /Delta	ACSR BERSIMIS	Normal route without constraint	400	"I" String	**43.2+**	**2X**	10.5	**64**	**64**	**64**	**0**	**13 - 19**
					"V" String	**35+**	**2X**	9.5	**54**				
					Tension	**35+**	**2X**	13	**61**				
			Forest	300	"V" String	**28.4+**	**2X**	9.5	**47**	**64**	**54**	**10**	**13 - 19**
					Tension	**28.4+**	**2X**	13	**54**				
			Urban area / populated area / approach section near substation	250	"V" String	**25.8+**	**2X**	9.5	**45**	**64**	**52**	**12**	**13 - 19**
					Tension	**25.8+**	**2X**	13	**52**				
765kV S/C	Horizon tal	ACSR BERSIMIS	Normal route without constraint	400	"I" String	**43.2+**	**2X**	15.6	**74**	**85**	**74**	**11**	**12 - 15**
					"V" String	**35+**	**2X**	14.4	**64**				
					Tension	**35+**	**2X**	18.2	**71**				
			Forest	300	"V" String	**28.4+**	**2X**	14.4	**57**	**85**	**65**	**20**	**12 - 15**
					Tension	**28.4+**	**2X**	18.2	**65**				
			Urban area / populated area / approach section near substation	250	"V" String	**25.8+**	**2X**	14.4	**55**	**85**	**62**	**23**	**12 - 15**
					Tension	**25.8+**	**2X**	18.2	**62**				
±800kV HVDC	Horizon tal	ACSR Lapwing	Normal route without	400	"Y" String	**44.4+**	**2X**	12.3	69	69	69	0	14 - 21

			constraint/ Forest/ Urban										
±500kV HVDC	Horizon tal	ACSR Lapwing	Normal route without constraint/ Forest/ Urban	400	"V" String	**31.8+**	**2X**	8.2	--	52	52	4	12.5 - 16.5
400kV D/C	Vertical	ACSR MOOSE	Normal route without constraint	400	"I" String	**31+**	**2X**	7.5	**46**	**46**	**46**	**0**	**10-18**
					"V" String	**26.4+**	**2X**	6.0	**38**				
					Tension	**26.4+**	**2X**	9.7	**46**				
			Forest	300	"V" String	**20.6+**	**2X**	6.0	**33**	**46**	**40**	**6**	**10-18**
					Tension	**20.6+**	**2X**	9.7	**40**				
			Urban area / populated area / approach section near substation	250	"V" String	**18.2+**	**2X**	6.0	**30**	**46**	**38**	**8**	**10-18**
					Tension	**18.2+**	**2X**	9.7	**38**				
400kV S/C	Horizon tal/ Vertical	ACSR MOOSE	Normal route without constraint	400	"I" String	**31+**	**2X**	10.5	**52**	**52**	**52**	**0**	**8-11**
					"V" String	**26.4+**	**2X**	9.1	**45**				
					Tension	**26.4+**	**2X**	13.0	**52**				
			Forest	300	"V" String	**20.6+**	**2X**	9.1	**39**	**52**	**47**	**5**	**8-11**
					Tension	**20.6+**	**2X**	13.0	**47**				

			Urban area / populated area / approach section near substation	250	"V" String	**18.2+**	**2X**	9.1	**36**	**52**	**44**	**8**	**8-11**
					Tension	**18.2+**	**2X**	13.0	**44**				
1200kV	Horizontal	ACSR Moose	Normal route without constraint/ Forest/ Urban	400	"V" String	**41.2+**	**2X**	24	89	89	89	0	16 - 18
220kV D/C	Vertical	ACSR ZEBRA	Normal route without constraint	350	"I" String	**22.6+**	**2X**	4.6	**32**	**35**	**32**	**3**	**6 - 12**
					"V" String	**19.8+**	**2X**	4	**28**				
					Tension	**19.8+**	**2X**	5.7	**31**				
			Forest	300	"V" String	**17+**	**2X**	4	**25**	**35**	**28**	**7**	**6 - 12**
					Tension	**17+**	**2X**	5.7	**28**				
			Urban area / populated area / approach section near substation	200	"V" String	**12.6+**	**2X**	4	**21**	**35**	**24**	**11**	**6 - 12**
					Tension	**12.6+**	**2X**	5.7	**24**				
132kV D/C	Vertical	ACSR PANTHER	Normal route without constraint	320	"I" String	**17+**	**2X**	3.9	**25**	**27**	**25**	**2**	**5 - 9**
					"V" String	**14.4+**	**2X**	3.5	**21**				
					Tension	**14.4+**	**2X**	5.3	**25**				

			Forest	200	"V" String	**10+**	**2X**	3.5	**17**	**27**	**21**	**6**	**5 - 9**
					Tension	**10+**	**2X**	5.3	**21**				
			Urban area / populated area / approach section near substation	150	"V" String	**8.4+**	**2X**	3.5	**15**	**27**	**19**	**8**	**5 - 9**
					Tension	**8.4+**	**2X**	5.3	19				
110kV D/C	Vertical	ACSR PANTHER	Normal route without constraint	305	"I" String	**16+**	**2X**	3.2	**22**	**22**	**22**	**0**	**5 - 9**
					"V" String	**13.6+**	**2X**	3.2	**20**				
					Tension	**13.6+**	**2X**	4.4	**22**				
			Forest	200	"V" String	**10+**	**2X**	3.2	**16**	**22**	**19**	**3**	**5 - 9**
					Tension	**10+**	**2X**	4.4	**19**				
			Urban area / populated area / approach section near substation	150	"V" String	**8.4+**	**2X**	3.2	**15**	**22**	**17**	**5**	**5 - 9**

					Tension	**8.4+**	**2X**	4.4	17				
66kV	Vertical	ACSR PANTHER	Normal route without constraint	250	"I" String	**12.5+**	**2X**	2.5	**18**	**18**	**18**	**0**	**4 - 7**
					"V" String	**10.4+**	**2X**	2.5	**15**				
					Tension	**10.4+**	**2X**	3.5	**17**				
			Forest	150	"V" String	**7.3+**	**2X**	2.5	**12**	**18**	**14**	**4**	**4 - 7**
					Tension	**7.3+**	**2X**	3.5	**14**				``
			Urban area / populated area / approach section near substation	100	"V" String	**6.1+**	**2X**	2.5	11	18	**13**	**5**	**4 - 7**
					Tension	**6.1+**	**2X**	3.5	13				

Note: (1) For normal Route without constraint , RoW width= Maximum of RoW (corresponding to I-string configuration, V string configuration , tension insulator)

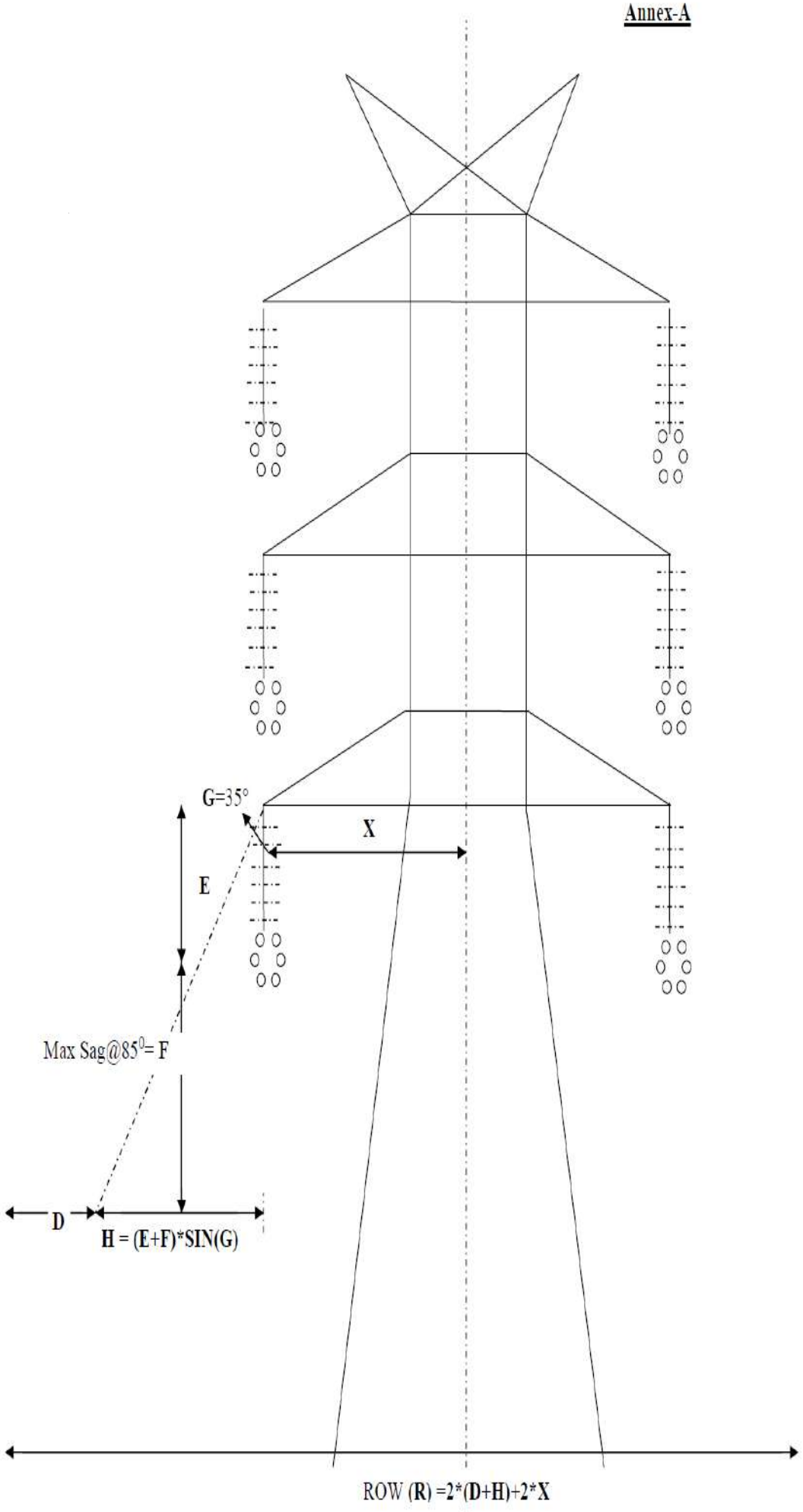
Note: (2) For urban area/ forest , RoW width= Maximum of RoW (corresponding to V string configuration , tension insulator)

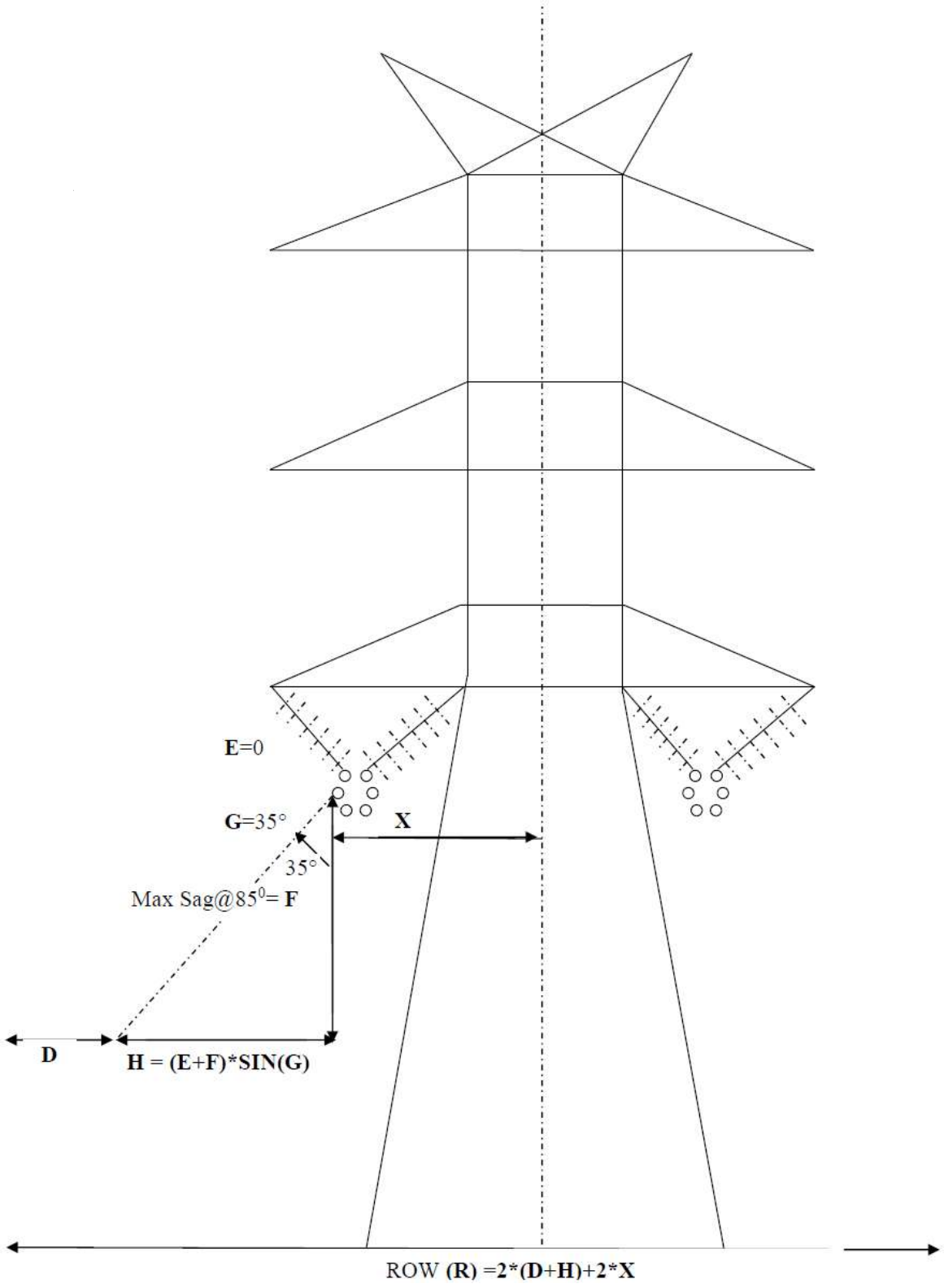
Note: (3) Typical 765kV D/C Tower diagram with "I" string & "V" string is attached at Annex. A

Note: (4) ** Lower values of base width corresponds to suspension tower / small angle towers and higher values corresponds to higher angle towers

Note: (5) For ±500 kV HVDC, ± 800 kV HVDC and 1200 kV HVAC lines, the reduction in RoW is not possible as it violates the minimum electrical field requirement at the edge of RoW (i.e 5kV/m at 1.8m height)

Annex-A




E=0
G=35°
X
35°
Max Sag@85^0= F
D
H = (E+F)*SIN(G)
ROW (R) =2*(D+H)+2*X

Annexure-II

of Urban RoW Guidelines

Indicative Cost Matrix for various alternatives at different voltage levels				
Voltage Level	**Type of tower**	**Span (in m)**	**Type of Conductor**	**Indicative cost for laying of transmission line per Km based on past experience (Rs In Crore)**
765 KV D/C	Normal	400	Hexa Zebra	3.83
		250	Hexa Zebra	4.79
	Narrow Base	400	Hexa Zebra	9.72
		250	Hexa Zebra	12.14
	Pole**	250	Hexa Zebra	13.41
	Underground Cable	Technologically not feasible		
400 KV D/C	Normal	400	Quad Moose	2.11
			Twin HTLS	1.41
			Twin Moose	1.24
		250	Quad Moose	2.64
			Twin HTLS	1.76
			Twin Moose	1.55
	Narrow Base	400	Quad Moose	5.36
			Twin HTLS	3.58
			Twin Moose	3.15
		250	Quad Moose	6.70
			Twin HTLS	4.48
			Twin Moose	3.94
	Pole	250	Quad Moose	7.39
			Twin HTLS	4.94
			Twin Moose	4.34
	Underground Cable			12
	GIL ***			70
220 KV D/C	Normal	350	Zebra	0.53
			HTLS	0.64
		200	Zebra	0.66
			HTLS	0.8
	Narrow Base	350	Zebra	1.34
			HTLS	1.63
		200	Zebra	1.68

Indicative Cost Matrix for various alternatives at different voltage levels				
Voltage Level	**Type of tower**	**Span (in m)**	**Type of Conductor**	**Indicative cost for laying of transmission line per Km based on past experience (Rs In Crore)**
			HTLS	2.04
	Pole	250	Zebra	1.86
			HTLS	2.24
	Underground Cable			7.2
132 KV D/C	Normal	320	Panther	0.36
		150	Panther	0.45
	Narrow Base	320	Panther	0.76
		150	Panther	1.14
	Pole	250	Panther	1.26
	Underground Cable			1.8
800kV HVDC (Horizontal)	Normal	400	Lapwing	2.69
		250	Lapwing	3.36
	Pole	250	Lapwing	9.42
500kV HVDC (Horizontal)	Normal	400	Lapwing	1.32
		250	Lapwing	1.65
	Pole	250	Lapwing	4.62

 # All costs are indicative exclusive of RoW Cost. For transmission lines mounted on poles, design span used is lower than normal span.

Note: Different insulator string configurations (I and V Types) would not account for considerable difference in per km cost of transmission lines, hence not have been factored in the matrix.

**** Poles prevalent are only for S/c. 765 KV D/C Pole under Design / R&D**

***** No GIL experience in country.**